Bull. Southern California Acad. Sci.
114(2), 2015, pp. 63–75

Effects of Ocean Recreational Users on Coastal Bottlenose Dolphins (*Tursiops truncatus*) in the Santa Monica Bay, California

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Abstract.—Coastal bottlenose dolphins (*Tursiops truncatus*) have been observed in proximity to swimmers, kayakers, stand-up paddle boarders and surfers along near-shore corridors in the Santa Monica Bay, California. From 1997 to 2012, a total of 220 coastal boat-based focal follows of dolphin schools were conducted in this area to determine a) the type and proximity of encounters between ocean recreational users and coastal dolphins, and b) the effects of these encounters on bottlenose dolphins' behavior. The majority of encounters involved dolphins and surfers (77.93%, n=145 encounters), and overall, neutral reactions were observed in response to encounters (61.93%, n=176 behavioral responses). Interactions between bottlenose dolphins and recreational users were recorded only once, and changes in dolphin behavior were observed more frequently when recreational users were at distances of less than three meters from a school. Although the current impact of human activities on coastal bottlenose dolphin behavior does not appear to be significant in the Santa Monica Bay, there is a need to: 1) adopt a precautionary approach in view of the increasing presence of ocean recreational users along this coastline, and 2) regularly monitor these encounters to determine potential changes in the type and proximity of encounters, as well as changes in dolphin behavioral responses.

Bottlenose dolphins (*Tursiops truncatus*, hereafter bottlenose dolphins) are known to inhabit both pelagic waters and coastal regions, including bays and tidal creeks (Leatherwood et al. 1983). In the Pacific Ocean, a coastal and an offshore population of this species are currently recognized, showing morphological, osteological, and molecular differentiations (LeDuc and Curry 1998; Rossbach and Herzing 1999). Studies have suggested that coastal bottlenose dolphins are highly mobile within the inshore waters of the Santa Monica Bay, but also spend a large amount of time foraging and feeding in the bay (Bearzi 2005). Further, this species utilizes the region as a regular transit corridor between foraging hotspots along the California coast (Defran and Weller 1999; Bearzi 2005). An estimated 50 million tourists visit the Santa Monica Bay beaches each year[1], many to partake in recreational activities including swimming, surfing, kayaking, and stand up paddle boarding. Swimmers, surfers, kayakers, and stand up paddle boarders are collectively defined as Ocean Recreational Users; hereafter ORUs. The year-round presence of both ORUs and bottlenose dolphins in the coastal waters of this region increases the likelihood of encounters between them.

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[1] Kreimann, S. H., Silverstrom, K. 2013. Beach and Marina Management Fact Sheet. County of Los Angeles Department of Beaches and Harbors. County of Los Angeles Department of Beaches & Harbors.

ORU presence has been proven to have adverse effects on dolphins in other areas worldwide. The occurrence of any vessel type, motorized or non-motorized, caused disturbances to dolphin behavior in Scotland (Pirotta et al. 2015). In New Zealand, Constantine (2001) observed sensitization and increased levels of avoidance with prolonged exposure to swimmers. Constantine (2002) also observed a decrease in bottlenose dolphin resting behavior when swimmers approached them in the wild. In Hawai'i, increased swimmer and kayak traffic led to decreased resting behaviors in spinner dolphins (*Stenella longirostris*; Samuels et al. 2000; Danil et al. 2005; Timmel et al. 2008; Ostman-Lind 2009). Spinner dolphins in Hawai'i also exhibited increased aerial behavior within their resting areas in correlation with the high number of swimmers in the area (Courbis and Timmel 2009). Indo-pacific dolphins (*Tursiops aduncus*) in Zanzibar displayed more frequent erratic (non-directional) behaviors in response to the increased presence of swimmers and boats (Stensland and Berggren 2007). Similarly, a study in West Cracoft Island, British Columbia found that when kayakers were present, killer whales (*Orcinus orca*) displayed avoidance behaviors, potentially resulting in changes to time spent feeding (Williams et al. 2011). Variations in behavioral states and decreased resting and feeding behaviors may cause a change in energetic demand, leading to changes in the lifetime fitness of the animal (Pirotta et al 2015; Williams 2011).

Based on the negative effects of these encounters between ORUs and cetaceans documented in other areas worldwide, the National Marine Fisheries Service (NMFS) has expressed concern that humans swimming with wild dolphins in the U.S. may qualify as harassment, leading to the disruption to their natural behavior (Spradlin et al. 1999). In an attempt to curb this disruption, the NMFS has advised vessels and swimmers to avoid approaching the animals at distance of less than 50 meters. Both ORUs and bottlenose dolphins have been frequenting the Santa Monica Bay since the 1930s and the tourism presence along this shoreline has increased, especially in recent times. The impact of ORU activities on bottlenose dolphins, however, has not yet been investigated in this area. This preliminary study describes the potential behavioral effects on coastal bottlenose dolphins of encounters with ORUs in this region, and provides suggestions for management and conservation measures aimed to mitigate the impacts on these animals.

Materials and Methods

Study area

The Santa Monica Bay study area (approximately $460km^2$, Fig. 1) is a shallow shelf bounded by the Palos Verdes Peninsula to the south (33°45'N, 118°24'W), Point Dume to the north (33°59'N, 118°48'W) and the edge of the continental shelf to the west. The bay contains two shallow water submarine canyons (Dume and Redondo) and the deeper Santa Monica Canyon. The Santa Monica Canyon begins at a depth of about 100m at the edge of the continental shelf. The bay has a mean depth of approximately 55m and a maximum depth of 450m. A shallow shelf between the Santa Monica and Redondo Canyons extends as a plateau from the 50m contour. Mild temperatures, short rainy winters and long, dry summers characterize the study area. Normal water surface temperatures range from 11 to 22°C.

Data collection and analysis

This study utilizes data collected in the years 1997–2012 as a part of a long-term year-round marine mammal research project. The data presented in this paper were analyzed retrospectively and some of the reported information was opportunistic in nature.

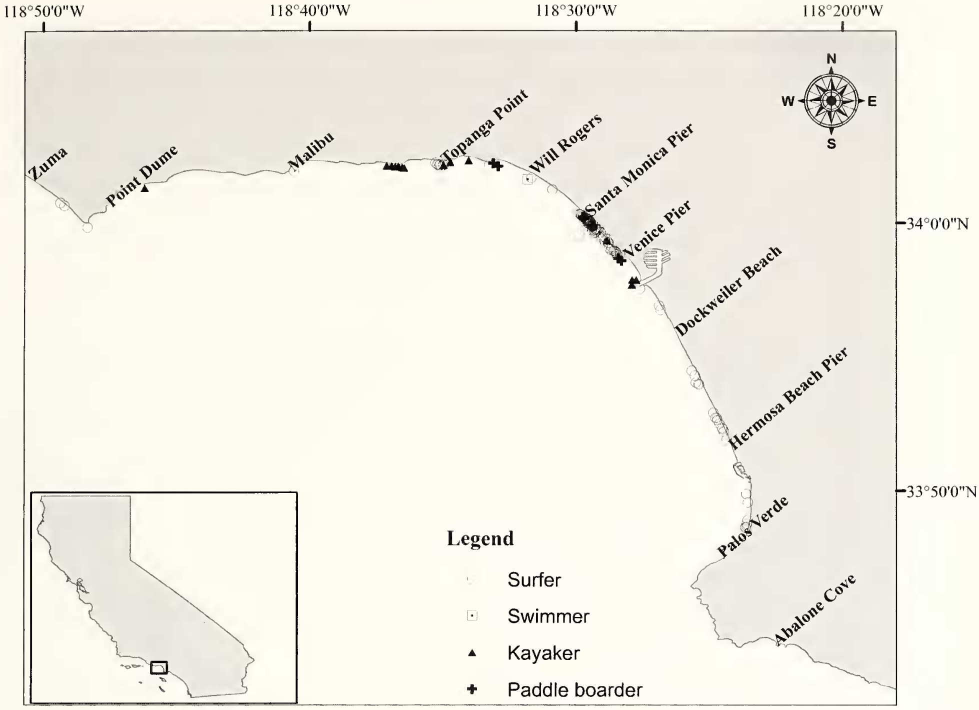

Fig. 1. Study area and locations of encounters between bottlenose dolphins and ORUs during surveys conducted in 1997-2012.

Coastal surveys (distance <1 km from shore) were conducted from February 1997 to September 2012 (excluding July 2002–August 2005, 2008 and 2010; Table 1), generally in the morning and early afternoon and in good weather conditions (Beaufort scale 2 or less, sea state 0 and visibility >300 m). Coastal surveys were conducted from 7m (1997–2000) and 10m powerboats (2001– 2002, 2006–2007), and two 17m sailboats (2005–2006, 2009–2012), at an average speed of 18km h^{-1}. Boat speed was reduced in the presence of dolphins, and sudden speed or directional changes were avoided. Trained research assistants approximated the dolphins' position (±30 m from the boat) and speed with respect to the boat's position using GPS. Focal follows were conducted on all dolphin groups, each attempted for a minimum of 30 minutes and lasting up to 250 minutes. Prior to potential encounters between ORUs and coastal dolphins and throughout observation, the research vessel attempted to maintain a distance of 50m from ORUs and the dolphin focal group, paralleling the school and allowing the undisturbed recording of encounters (for full methodology: Bearzi 2003). Any boat disturbances, such as bowriding, were recorded (for definitions of boat disturbance: Bearzi 2003). The survey area was divided at the Marina del Rey harbor, and coastal surveys were conducted either to the north or south of the harbor depending on favorable weather conditions.

Data for coastal and offshore bottlenose dolphins were divided exclusively based on their distance from shore: all bottlenose dolphins observed during coastal surveys up to 1 km from shore were considered coastal; all bottlenose dolphins observed during surveys at >1km from shore were considered offshore. For this study, only data on coastal bottlenose dolphins were analyzed. Behavioral data collected opportunistically from July

Table 1. Summary of research effort for coastal surveys in Santa Monica Bay conducted from 1997 to 2012. No data were collected: July 2002–August 2005, 2008, and 2010. BD=bottlenose dolphins.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2009	2011	2012	Totals
N of surveys	16	55	39	33	27	9	3	14	8	3	6	7	220
N of sightings	7	58	32	16	18	6	6	21	16	5	13	11	209
Survey hours	123	214	155	119	121	60	16	23	41	11	29	25	937
Number of 5 min samples	68	722	345	212	273	38	68	147	135	19	182	72	2,281
Hours of BD observation	6	60	29	18	23	3	6	12	11	2	15	6	190

to December 1996 (58 hours of field observations) provided a framework of information to design the behavioral sampling procedures systematically adopted from January 1997 onward (Bearzi 2003). Data were collected with laptop computers and occasionally with tape recorders. Throughout all focal follows, the number of animals, behaviors of the dolphin group, and aggregation/associations with other marine mammal species were recorded at 5-minute intervals (Bearzi 2005). Behavioral data collected without ORUs present and before focal groups encountered ORUs were used as controls for the behavioral data in which ORUs were present. When more than one ORU was present in the study area, each ORU was recorded as one ORU. The number of dolphins was later verified through photo-identification and video analyses.

When coastal bottlenose dolphins were observed within 50m of ORUs, behavioral data continued to be recorded at 5-minute intervals to determine changes in school size, behavioral state, group formation, and surfacing mode as a result of their encounters with ORUs. Observed responses to potential disturbances to the bottlenose dolphins (i.e. the research vessel) and approximate distances between dolphin focal groups and ORUs were recorded. Data analyses were performed using R and Microsoft Excel 2011. A general linear model (GLM) was conducted in R and used to analyze which factors were most likely to be correlated with behavioral changes. All other data analyses on sighting length, number of dolphins involved in encounters, distances between dolphins and ORUs, rates of dolphins' behavioral changes were performed in Microsoft Excel 2011. Species distribution data were plotted with ArcGIS 10.2.1.

Definitions

For the purposes of this study, the following definitions were used:

Dolphin school: dolphins in continuous association with each other and within visual range of the survey team (Weller 1991);

Focal group: any group of animals observed in association, moving in the same direction and usually engaged in the same activity (Shane 1990). Groups of animals not belonging to the observed focal group and spotted at distance were recorded, but their number was excluded from group size calculation;

Behavioral state: a broad category of activities, such as feeding behavior, which integrates several individual behavior patterns into a recognizable pattern (Weaver 1987; for additional definitions see Bearzi 2005);

Encounter: any instance in which at least one bottlenose dolphin was observed within 50 meters of any type and number of ORU;

Association (A): an encounter between one or more dolphin and one or more of the four ORUs at a distance of 10-20 meters;

Close Association (CA): an encounter between one or more dolphins and any ORU at a distance of 3 meters up to 10 meters;

Potential Interaction (PI): an encounter between one or more dolphins and any ORU at a distance equal to or less than 3 meters;

Interaction (I): observed physical contact between an ORU and one or more dolphins.

Changes in behavioral states of the dolphin were defined as follows:

Avoidance – when one or more dolphins altered behavior to prevent a closer encounter with an ORU;

Change in direction – when one or more dolphins maintained the same speed but altered direction of approach to ORUs;

Dive - when one or more dolphins altered their behavior to display a dive longer than 15 seconds in the presence of ORUs;

Aerial reaction – when one or more dolphins displayed an aerial behavior (e.g., bow, leap) in the presence of ORUs;

Vocal reaction – when one or more dolphins displayed an audible response such as chuffing in the presence of ORUs;

Stationary reaction – when one or more dolphins displayed a motionless behavior on the surface for more than five seconds (e.g., floating, rafting) in the presence of ORUs;

Percussive reaction – when one or more dolphins hit the water with any portion of the body (e.g., breach, tail slap) in the presence of ORUs;

Neutral reaction – when one or more dolphins showed none of the above behavioral changes in the presence of ORUs.

Results

Data were collected during 220 coastal surveys along the Santa Monica Bay coastline in the years 1997-2012, with an average of three surveys per month (Table 1). A total of 937 hours were spent searching for coastal bottlenose dolphin resulting in 209 sightings, 82.78% of which were conducted in good weather conditions (Beaufort scale 2 or less). A significantly higher number of surveys were carried out in the northern study area (t=3.24, DF=26, P<0.005). Sightings lasted an average of 55.84 minutes (SD=37.74, SE=2.61, range 5-250 minutes, n=209).

During the study period, 145 encounters were recorded between 72 bottlenose dolphin schools and ORUs throughout the survey area (34.45%, n=209 sightings; Fig. 1, Table 2). An average of nine dolphins were involved in each encounter (SD=4.66, SE=0.03, range 2-19 individuals, n=145 encounters). Few encounters lasted more than five minutes (4.55%, n=176 encounters). It was common for a single bottlenose dolphin focal group to experience two or more encounters with an ORU during observation (40.28%, n=72 schools; Table 2). Multiple ORUs were encountered by 16.67% of focal groups (n=72), and surfers were the most common ORU encountered by focal groups (77.93%, n=145 encounters; Table 2). Encounters occurred most commonly between ORUs and bottlenose dolphins within 3 to 10 meters (close associations; 40%, n=145 encounters; χ^2_5=1.41, n=22, p=0.02; Fig. 2, Fig. 3). Physical contact (interaction) between an ORU and bottlenose dolphin occurred on only one occasion.

Bottlenose dolphins responded neutrally to 61.93% of encounters with ORUs (n=176 behavioral responses, Fig. 4). Without ORUs present, behavioral changes occurred in 48.35% of 5-minute behavioral samples. When ORUs were present, however, behavioral changes occurred in 31.43% of 5-minute samples. This difference in the rates of change from one behavior to another was statistically significant ($F_{1,20}$=4.79, p<0.05),

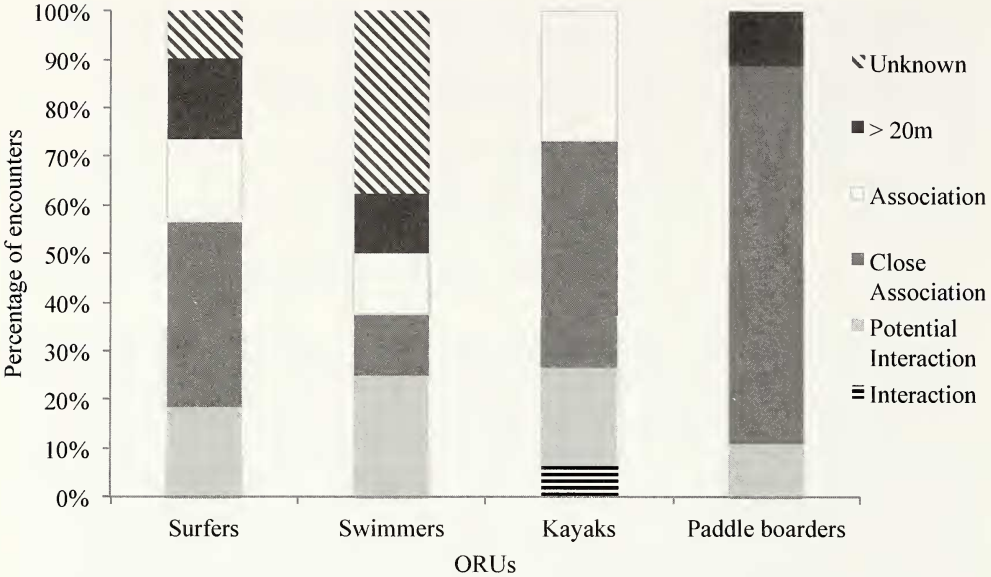

Fig. 2. Distances between different ORUs and bottlenose dolphin/s for each encounter.

suggesting that the presence of ORUs alters the rate of behavioral change in bottlenose dolphins. The most common behavioral changes observed by a focal group were either a change of surface mode (11.72%, n=176 behavioral responses) or "other" reactions, which included activities such as "chin up" (3.84%), "tail up" (0.57%), mating (0.57%), circling (0.57%), splitting into subgroups (0.57%), or feeding (0.57%) (collectively: 6.25%, n=176). The least common response to an encounter with an ORU was one or more dolphins displaying percussive or aerial behaviors (Fig. 4). Aerial reactions occurred solely as a result of encounters with surfers (2.14%, n=140 responses; Fig. 4).

Focal groups responded to the presence of the research vessel by bowriding during 4.17% of the 5-minute samples in which an encounter occurred. If the dolphin group was bowriding in the 5-minute behavioral sample prior to the encounter, 75% of encounters resulted in a behavioral change. Focal groups did not avoid or approach the vessel in any 5-minute interval in which an encounter occurred. However, throughout focal follows of groups that encountered ORUs, 4.17% approached the vessel and 2.78% avoided the vessel (n=72 schools). None of the focal groups that approached or avoided the vessel exhibited a behavioral reaction to an encounter with an ORU.

Table 2. Number of schools and encounters per ORU type and number of schools that experienced multiple ORU encounters.

	Surfers	Swimmers	Kayakers	Paddle boarders	Total
N of schools	48	7	11	6	72
Percentage of total schools	*66.67%*	*9.72%*	*15.28%*	*8.33%*	*100%*
N of encounters	113	8	15	9	145
Percentage of total encounters	*77.93%*	*5.52%*	*10.34%*	*6.21%*	*100%*
Schools with >1 encounter	24	1	2	2	29
Percentage of total schools	*50.00%*	*14.29%*	*18.18%*	*33.33%*	40.28%
Schools with >2 encounters	15	0	1	1	17
Percentage of total schools	*31.25%*	*0%*	*9.09%*	*16.67%*	23.61%

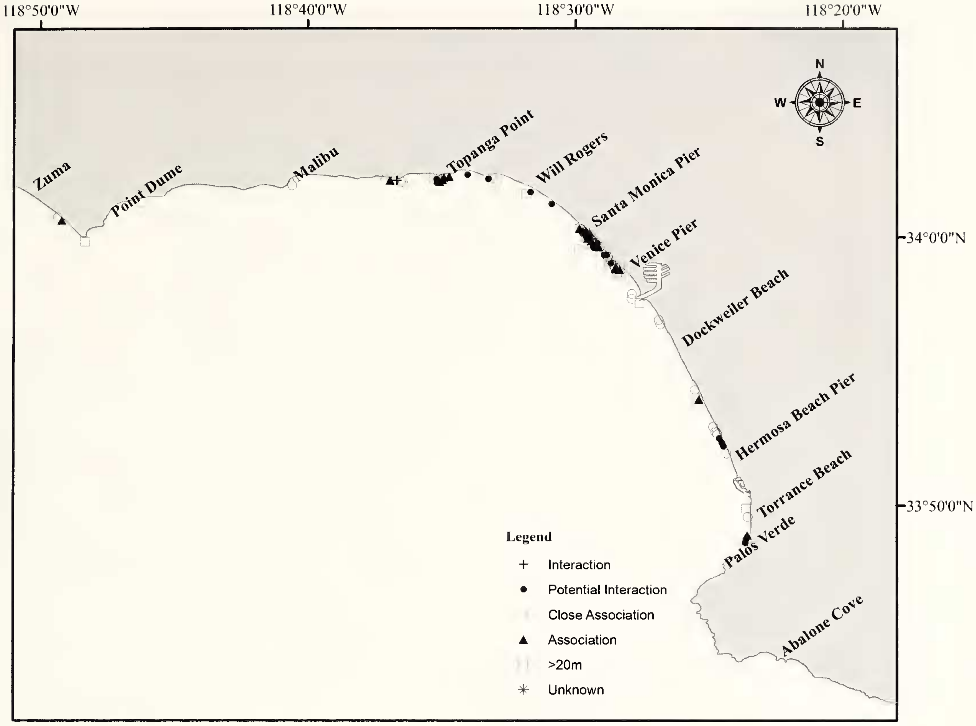

Fig. 3. Distance between ORUs and bottlenose dolphin/s at location of each encounter.

The results of a general linear model indicated that the group form of the focal dolphins during the 5-minute behavioral sample prior to the encounter might be a factor in determining whether a behavioral change would occur as a result of an encounter. Prior to encountering an ORU, dolphin groups that were at mixed distances ($p<0.05$,

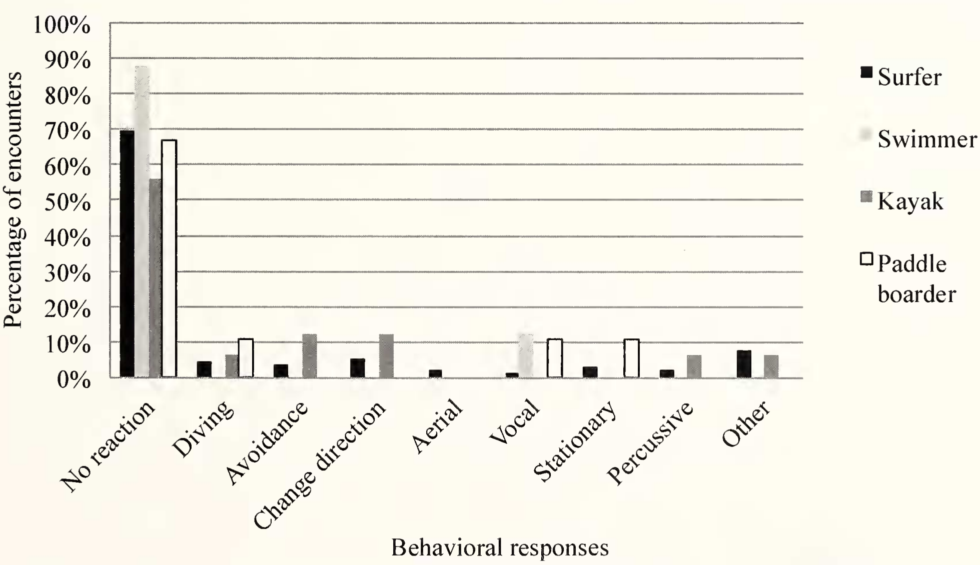

Fig. 4. Reactions (or lack of) to an encounter with one or more surfer, kayaker, stand-up paddle boarder, and/or swimmer during a 5-minute behavioral interval.

Table 3. Number of encounters and schools in which an ORU approached a dolphin or a dolphin approached an ORU.

ORU approach	Surfers	Swimmers	Kayakers	Paddle boarders	Total
Encounters	13	1	4	2	20
% of encounters	11.50%	12.50%	26.67%	22.22%	13.79%
Schools	7	1	1	2	11
% of schools	14.58%	14.29%	9.09%	22.22%	15.28%
Dolphin approach					
Encounters	5	0	1	0	6
% of encounters	4.42%	0%	6.67%	0%	4.14%
Schools	4	0	1	0	5
% of schools	8.33%	0%	9.09%	0%	6.94%

SE=0.153), widely dispersed with more than 50 meters between individuals ($p<0.05$, SE=0.171), or in a tight form with less than one adult body length between individuals ($p<0.05$, SE=0.462), were more likely to exhibit a behavioral change as a result of that encounter. Only one focal group involved in an encounter was described as being widely dispersed in the 5-minute behavioral interval prior to the encounter. No other behavioral data for this 5-minute interval were correlated with a behavioral change as a result of an encounter.

Bottlenose dolphins were approached by one or more ORU in 13.79% of all encounters, and dolphin focal groups approached ORUs in 6.94% of recorded encounters ($n=145$ encounters; Table 3). When ORUs approached dolphins, behavioral changes occurred in 50% of encounters ($n=20$), compared with 75% when dolphins approached an ORU ($n=4$). When dolphins approached ORUs, all behavioral changes were changes in direction.

The distance between dolphins and an ORU during an encounter was an important factor in determining whether a behavioral change would occur as a result of the encounter (Fig. 5). This factor was more important than the type of ORU involved in the encounter (Fig. 5). Encounters classified as potential interactions were significantly more likely to lead to behavioral changes than encounters at distances greater than 3 meters ($p<0.001$, SE=0.126). The type and number of ORUs present and whether a human or dolphin approached during the encounter were not significant when added to the model. Because the addition of these variables increased the AIC score of the GLM (177.76 to 187.15), they were excluded from the final version.

Discussion

Surfers were the most common ORU encountered by dolphins in the study area. This result is likely due to the fact that Southern California has been a top US surf destination since the 1930's (Irwin 1973) and the sport continues to grow in popularity. On the contrary, swimmers were only occasionally involved in encounters with dolphins along this coastline. This may be explained by the presence of these ORUs close to the beach while coastal bottlenose dolphins tend to move slightly more offshore. In other areas where dolphins are found in extremely shallow waters, encounters with swimmers appear to be more likely, making these animals prone to being subjected to swim-with-the-dolphins programs and food-provisioned encounters. For instance, in Florida (Samuels and Bejder 2004; Cunningham-Smith et al. 2006), Tonga (Kessler et al. 2013), and New Zealand (Neumann and Orams 2006), dolphins are frequently exposed to swim-with

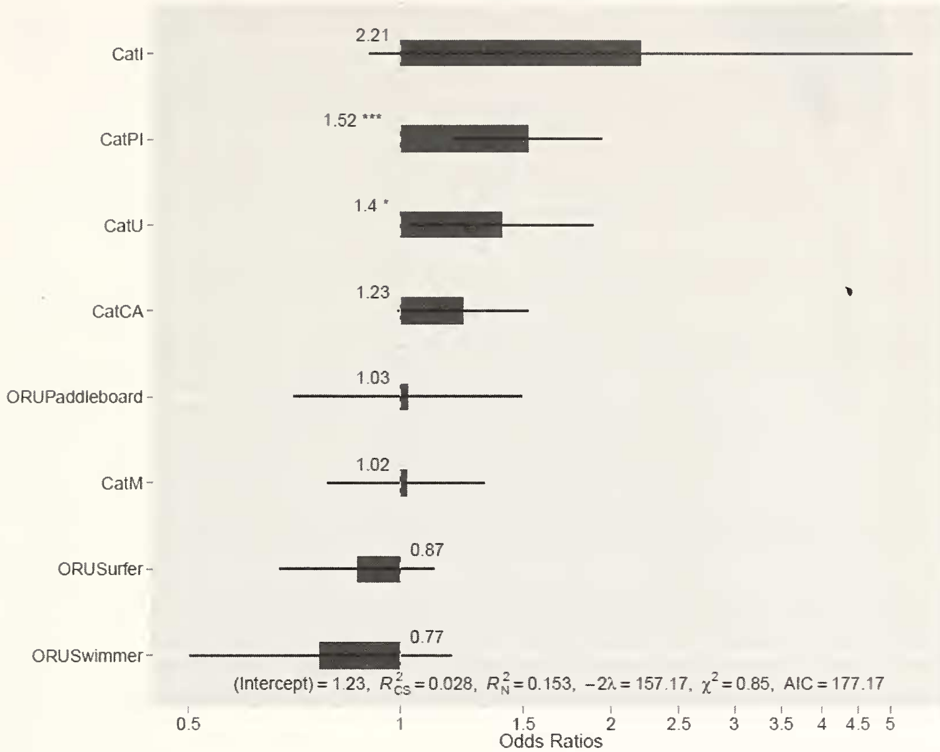

Fig. 5. Visualized results of a GLM depicting the effect of ORU type and distance from the focal group on dolphin behavioral responses. Cat I: Interactions, Cat PI: Potential Interactions, Cat U: Unknown Cat CA: Close Associations, ORU P: Paddle boarders, Cat M: More than 20 meters, ORU S: Surfers, ORU W: Swimmers.

dolphins programs and food-provisioned encounters with humans. In these situations, swimmers actively pursued dolphins. Based on this study, bottlenose dolphins in the Santa Monica Bay were neither discouraged (by frequent ORU encounters) nor encouraged (through food-provisioning) from interacting with ORUs. Because encounters in this region occurred by chance, there were likely fewer total encounters between dolphins and humans compared to those in incentivized or active pursuit settings like Australia and Brazil (Samuels et al. 2000).

Encounters between stand-up paddle boarders and bottlenose dolphins were recorded least often, and were observed mainly in the last few years of research. Stand-up paddle boarding was introduced in California in 2002, and by 2009 it was the fastest growing paddle-sport in North America[2]. This study shows that multiple encounters between ORUs and dolphins were common, but few encounters lasted more than five minutes. This could be attributed to several factors such as oceanographic conditions, specific behavioral patterns displayed by dolphins in this area (e.g., large amounts of time spent foraging; Bearzi 2005), and U.S. regulations such as the Marine Mammal Protection Act. As a comparison, in areas where swim-with-the-dolphin programs are allowed, this type of encounter typically was 35-60 minutes in duration (Constantine and Baker 1996; Samuels et al. 2003).

[2] Addison, Corran. 2010. The History of Stand Up Paddling. Editorial. *SUP World Mag* 2010.

Our results indicated that dolphins changed their behavior more often when no ORUs were present. The research vessel appeared to have a negligible effect on dolphin behavior. This suggests that the presence of ORUs may be altering dolphin behavior by preventing behavioral changes rather than increasing the amount of change. However, far more data were collected when no ORUs were present. The opportunistic nature of the study may have affected the number of ORU encounters observed. More targeted data collection on dolphin behavior in the presence of ORUs is needed to further elucidate this phenomenon.

In the Santa Monica Bay, only 20% of the dolphins approached by ORUs changed their direction of travel, compared to 40% in a New Zealand swim-with program (Constantine and Baker 1996). In several cases, dolphins that were highly habituated to ORUs and actively sought out human interaction displayed high rates of aggression toward ORUs (Samuels and Bedjer 2004, Scheer 2010) or have sustained an anthropogenic injury (Samuels and Bedjer 1998). On one occasion, aggressive behavior by a dolphin resulted in a human death (Santos 1997). Our study did not reveal any instances of bottlenose dolphin aggression toward ORUs or vice versa, but as dolphins become increasingly habituated to ORU presence, aggression may become a concern.

As expected, our preliminary results indicated that the proximity of ORUs to dolphins during encounters was the best predictor of whether a behavioral reaction would be elicited from the dolphin. If one or more dolphin and an ORU came within three meters of one another during an encounter, a behavioral change was likely to occur. Increased dolphin behavioral changes as a result of close encounters with ORUs are consistent with Bedjer et al. (1999) findings, which determined that the distance between an ORU and dolphins during an encounter was the most reliable predictor of a change in dolphin behavior. Williams (2011) also found that orcas (*Orcinus orca*) were more likely to exhibit avoidance behaviors when approached by kayaks at close range. Kayakers may be of particular interest for looking at these types of interactions, as they can elicit the same response from a dolphin school as a powerboat (Lusseau 2003), and have been found to associate with dolphins more often than motorized vessels in the same area (Nichols et al. 2001).

Conclusions

This preliminary study shows that coastal bottlenose dolphins in the Santa Monica Bay are not subjected to prolonged encounters with ORUs, and these dolphins appear to be generally "habituated"[3] to ORU presence. The apparent reduction in behavioral changes in response to ORUs, as well as the high occurrence of "no reactions," are in accordance with Filby et al. (2014) findings that habituated dolphins display reduced avoidance behaviors.

Coastal bottlenose dolphins are now well recognized as a sentinel species[4] and key indicators of coastal habitat health (Simberloff 1998; Wells et al. 2004; Bossart 2011; Reif 2011). Although the current impact of ORU activities on bottlenose dolphin behavior does not appear to be significant in Santa Monica Bay, there is a need to adopt a precautionary approach in view of: a) the increasing presence of ORUs along this

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[3] Thorpe (1963) defines habituation as "the relative persistent waning of a response as a result of repeated stimulation, which is not followed by any kind of reinforcement."

[4] Barometers for current or potential negative impacts on individual-and-population-level animal health (Bossart 2011)

coastline, and b) studies in other regions showing the adverse effects of human recreational activities on coastal bottlenose dolphins.

Dolphin responses to increased human presence can have lasting population effects. For instance, habituation due to increased human presence may have intensified the probability of boat strike mortality in Hector's dolphins (Stone and Yoshinaga 2000). In New Zealand, the Hector's dolphin population decreased due to a rise in dolphin ecotourism (Bejder et al. 2006), and dolphins abandoned previously favored habitat (Bedjer 1997) as a result of encounters with humans. Martinez et al. (2011) suggested that encounters that seem positive (i.e. dolphins approaching swimmers) can still cause a reduction in crucial behavior such as feeding. Additionally, it has been demonstrated that dolphin presence can cause a significant increase in ORUs, thereby increasing the disturbance (Östman-Lind 2009). Kayakers in Hawaii changed their behavior when dolphins were present in an attempt to get closer to the dolphin school (Timmel et al. 2008). Considering the growing popularity of recreational activities along the Santa Monica Bay coastline, there could be a risk of a similar response in this area. Efforts should be directed to ensure that ORUs are aware of marine mammal observation guidelines, such as the requirement to maintain a minimum distance of 50 meters during an encounter with a dolphin.

Educational programs conducted in marine protected areas to inform the public of the importance of marine mammals have been shown to aid in the enforcement of the parameters of the Marine Mammal Protection Act and decrease disturbances to marine mammals (Gunvalson 2011). Similar educational programs designed to explain marine mammal observation guidelines to ORUs along the Santa Monica Bay coastline could further minimize the effects of ORU presence on bottlenose dolphins.

In conclusion, this preliminary investigation suggests the need of regular monitoring of coastal bottlenose dolphins and encounters with ORUs to determine potential changes in these animals' behavior. Also, it suggests the necessity of implementing public education program and management measures to ensure that dolphins remain undisturbed by the growing number and diversity of anthropogenic presence in the bay.

Acknowledgements

Field research was funded by Ocean Conservation Society. Special thanks to the Los Angeles Dolphin Project volunteers and researchers. Special acknowledgments to IFAW for the Logger software. Fieldwork was carried out under the current laws of California and the General Authorization for Scientific Research issued by NOAA (Files No. 856-1366 and No. 5401811-00 and No. 16381).

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